

**CLASS 385, OPTICAL WAVEGUIDES****SECTION I - CLASS DEFINITION****GENERAL STATEMENT OF THE CLASS SUBJECT MATTER**

A. Subject matter appropriate to this class falls into one of the following categories: (1) An optical waveguiding element, per se, or a grouping thereof which conveys light from one point to another through an optically transparent elongated structure by modal transmission, total internal reflection, or total reflectorization. (2) A combination of an optical waveguiding element with an additional broadly recited optical element which couples light thereto or therefrom or a combination including a broadly recited optical element which couples light between plural optical waveguiding elements. (3) A combination of an optical waveguiding element with structure which mechanically joins this waveguiding element with another or with a diverse optical element. (4) An optical modulator where the modulation of a light wave characteristic is performed exclusively within an optical waveguiding element. (5) Other miscellaneous devices formed of an optical waveguide (e.g., a waveguide sensing device) and supplemental devices which are limited to use with an optical waveguide (e.g., an external clamp or retainer) not otherwise classifiable.

B. Nominally claimed structure, external to this class in combination with apparatus under the class definition, is classified in this class unless provided for in the appropriate external class.

C. Significantly claimed structure, external to this class claimed in combination with structure under the class definition, is classified in the class appropriate to the external device unless specifically excluded therefrom.

- (1) Note. A detailed optical amplifier/frequency converter, per se, or such subject matter in combination with additional wave guide structure is classified elsewhere. The nominal recitation of any type of optical amplifier/converter together with additional waveguide structure is classified in this class (385) wherein such combination meets the class requirements.
- (2) Note. Optical modulation that occurs within the area of total internal reflection of an optical waveguide belongs in this class,

whereas modulation occurring outside the optical waveguide is classified elsewhere.

- (3) Note. If significant details beyond the nominal recitation of a detector or light source are claimed, classification is elsewhere.
- (4) Note. A device having an optical wave going through a bulk material, such as a semiconductor, glass, etc., does not belong in this class since the wave is not totally confined within the boundaries of the bulk material. If, however, the wave is totally confined within an area but specified leakage, as designed, is built into the area for some desired results, this would then belong in this class.
- (5) Note. The optical fibers and waveguides classified in this class are final products, suitable for immediate optical transmission. Excluded from this class are articles of intermediate shape (e.g., blanks, preforms) from which optical fibers and waveguides are made (as by drawing or extruding). For the classification of such intermediate articles, see References to Other Classes, below.
- (6) Note. Fiber optics refers to optical devices for conveying light or images through a particular configuration of glass or plastic fibers. Incoherent fiber optic bundles will transmit light but not an image. Coherent fiber optic bundles can transmit an image through small, clad optical fibers where the fiber ends have similar positions at opposite bundle ends.
- (7) Note. An optical fiber waveguide is basically a light guidance system that is cylindrical in shape. The fiber relies upon modal transmission to transmit light along its axial length. Light enters one end of the fiber and emerges from the opposite end with only minimal loss.
- (8) Note. The thin-film waveguide is a thin dielectric guide film of high refractive index formed adjacent to a substrate or support region of lower refractive index. The thin-film relies upon modal transmission to transmit light along its length. Light enters

one end of the thin-film where it is processed (e.g., modulated or switched) and emerges from the opposite end.

- (9) Note. Combinations including an optical waveguide and a device of the Class 257 type are classified here provided the combination does not meet the requirements of a still larger system class.
- (10) Note. A tee coupler is an optical component used to interconnect a number of terminals through optical waveguides by using partial reflections at dielectric interfaces or metallic surfaces, or by splitting the optical waveguide bundle.
- (11) Note. Modal Transmission is a form of guide-wave propagation characterized by a particular field pattern.
- (12) Note. A laser in an integrated optical circuit is classified herein (385).

## SECTION II - REFERENCES TO OTHER CLASSES

### SEE OR SEARCH CLASS:

- 8, Bleaching and Dyeing; Fluid Treatment and Chemical Modification of Textiles and Fibers, appropriate subclasses for chemical treatment of fibers.
- 29, Metal Working, subclasses 700+ for various metal working jigs, and subclasses 854-873 for assembling electrical terminals to conductors or circuits (e.g., using ferrules, splicing, etc.).
- 33, Geometrical Instruments, subclass 1 for optical readout therefrom and subclasses 227+ for straightline light ray type instruments.
- 40, Card, Picture, or Sign Exhibiting, subclasses 427+ for illuminated special effects display, subclasses 451 and 452 for illuminated changing exhibitor, and subclasses 546 and 547 for illuminated signs (e.g., by fiber optics).
- 57, Textiles: Spinning, Twisting, and Twining, subclasses 3+ for cable forming by twisting.
- 65, Glass Manufacturing, subclasses 385+ for processes of forming optical fibers, waveguides, and preforms, particularly subclass 386 for processes of forming planar waveguides; subclasses 388, 389, 390, and 397+ for forming optical fibers or waveguides having specified composition; subclasses 393, 402, and 403 for

forming optical fibers or waveguides having particular cross section or configuration; subclasses 406+ for processes of forming combined with joining optical fibers or waveguides; subclasses 413+ and 430+ for processes of forming combined with coating optical fibers or waveguides; and subclasses 489+ for apparatus for forming optical fibers or waveguides.

- 70, Locks, digest 51 for light sensitive lock control.
- 73, Measuring and Testing, subclass 293 for liquid level/depth gauge with illumination, subclasses 488+ for speed/acceleration testing that may use optical waveguides, subclass 653 for optical indication of vibration, subclass 705 for an optical fluid pressure gauge, subclass 800 for optical stress or strain testing, and subclass 861.08 for optical measurement of volume or rate of flow.
- 83, Cutting, subclass 913 for filament-to-staple-fiber cutting.
- 102, Ammunition and Explosives, subclass 201 for optical explosive ignition.
- 116, Signals and Indicators, subclass 202 for visual light signal indicators.
- 126, Stoves and Furnaces, subclasses 569+ for solar heat collectors which may utilize optical waveguides.
- 138, Pipes and Tubular Conduits, appropriate subclasses for cable containing ducts.
- 156, Adhesive Bonding and Miscellaneous Chemical Manufacture, subclass 158 for methods of joining fibers (bonding) end-to-end.
- 174, Electricity: Conductors and Insulators, subclasses 68.1+ for electrical cables, per se, and particularly subclass 70 for combined optical/electrical cables or a submarine repeater housing.
- 200, Electricity: Circuit Makers and Breakers, subclasses 310+ for illuminated switch indicators and digest 47 for light guide switch indicators.
- 204, Chemistry: Electrical and Wave Energy, subclass 192.29 for forming a transparent optical conductor by sputtering.
- 211, Supports: Racks, subclasses 13+ for special article supports.
- 216, Etching a Substrate: Processes, especially subclasses 24+ for methods of making an optical device by chemical etching combined with an additional manufacturing step.
- 219, Electric Heating, subclasses 121.36+ for methods and apparatus for fusing (splicing) optical fibers.

- 225, Severing by Tearing or Breaking, subclasses 94+ for apparatus which scribes then breaks optical fibers.
- 226, Advancing Material of Indeterminate Length, appropriate subclasses for advancing fibers through a tube (i.e., cable).
- 235, Registers, subclass 473 for optical fiber coded record sensors.
- 244, Aeronautics and Astronautics, subclass 3.12 and 3.16+ for missiles guided by optical fibers.
- 250, Radiant Energy, subclasses 227.11+ for optical or pre-photocell systems having a light conductor and subclass 577 for a fluid level optical system.
- 257, Active Solid-State Devices (e.g., Transistors, Solid-State Diodes), subclasses 13, 79 through 103 and 918 for incoherent light emitting injection luminescent devices, subclasses 80 through 85 for semiconductor light emitting sources combined with semiconductor light responsive devices, subclasses 10, 11, 21, 53 through 56, 72, 113 through 118, 184 through 189, 225 through 234, 257, 258, 290 through 294, 414, and 431 through 466 for light responsive active semiconductor devices, and subclasses 446 and 499+ for integrated circuit devices with electrically isolated components, in general, and other appropriate subclasses for specific type devices in integrated circuits.
- 264, Plastic and Nonmetallic Article Shaping or Treating: Processes, subclasses 1.24+ for shaping, treating, or extruding optical fibers, waveguides, or preforms.
- 285, Pipe Joints or Couplings, subclass 260 for coupling where both members are pliable and non-metallic.
- 313, Electric Lamp and Discharge Devices, subclass 372 for a cathode-ray tube with light conducting fiber or rod.
- 324, Electricity: Measuring and Testing, subclasses 96+ for electrical testing using radiant energy.
- 333, Wave Transmission Lines and Networks, subclasses 24+ for coupling networks; subclasses 141+, 150+ and 157+ for delay lines; and subclasses 209+ for waveguide tunable filters.
- 340, Communications: Electrical, subclasses 555+ for intrusion detection by light beam; subclass 815.42 for a visual indicator with light piping; and subclasses 853.1+ for wellbore telemetry which may include optical waveguides.
- 341, Coded Data Generation or Conversion, subclass 137 for A-to-D or D-to-A conversion using fiber optics.
- 345, Computer Graphics Processing and Selective Visual Display Systems, subclasses 180+ for light pen input visual display systems.
- 346, Recorders, subclass 33 for well logging which may use optical waveguides.
- 348, Television, subclass 197 for mechanical-optical scanning with fiber optics, subclass 359 for camera with fiber optics, and subclass 804 for video display with fiber optics.
- 355, Photocopying, subclass 1 for photocopying with fiber optics.
- 356, Optic: Measuring and Testing, subclass 73.1 for optical fiber or waveguide inspection, subclasses 241.1+ for inspection borescopes in general, subclass 459 for ring laser gyros including optical waveguides, and subclass 454 for Fabry-Perot cavities.
- 358, Facsimile and Static Presentation Processing, subclass 484 for scanning with fiber optics or optical waveguides and subclass 901.1 for fiber optic cross-reference art collection.
- 359, Optics: Systems (Including Communication) and Elements, appropriate subclasses for optical systems such as communications systems which may utilize an optical waveguide, and for a detailed optical amplifier/frequency converter, per se, or such subject matter in combination with additional wave guide structure. Modulation occurring outside the optical waveguide is classified in Class 359.
- 361, Electricity: Electrical Systems and Devices, subclasses 748+ for housings with electrical connection of PC boards.
- 362, Illumination, subclasses 551+ for illumination systems which utilize an optical fiber.
- 365, Static Information Storage and Retrieval, subclass 112 for photoconductive static information storage or retrieval.
- 367, Communications, Electrical: Acoustic Wave System and Devices, subclass 25 for well logging using fiber optics and subclasses 140+ for acoustic transducers in general.
- 369, Dynamic Information Storage or Retrieval, subclass 18 for optical reading of a mechanical record.
- 372, Coherent Light Generators, subclass 6 for optical fiber lasers; also see the Class Definition, References to Other Classes.
- 374, Thermal Measuring and Testing, subclass 131 for thermal measurement using optical fibers.
- 379, Telephonic Communications, subclasses 56.1+ for light wave link for speech or paging signal.
- 399, Electrophotography, subclass 64 for optical detector of toner in a developing unit, subclass

- 118 for optics with particular modular or displaceable structure, subclass 137 for optical intermediate storage of original image formation, subclasses 196+ for variable magnification, subclass 218 for exposure lens, and subclass 219 for exposure of an image formation having fiber optics.
- 425, Plastic Article or Earthenware Shaping or Treating: Apparatus, subclass 802 (Cross-Reference Art Collection) for cable tube or rod splicing.
- 427, Coating Processes, subclasses 163.1+ for processes of coating optical fibers, filaments, rods, or waveguides.
- 428, Stock Material or Miscellaneous Articles, subclasses 364+ for miscellaneous filaments or fibers; subclass 542.8 for articles of intermediate shape (e.g., blanks, preforms) from which optical fibers and waveguides are made (as by drawing or extruding).
- 433, Dentistry, subclass 29 for dental handpieces provided with optical transmission cables for illuminating the work.
- 439, Electrical Connectors, appropriate subclasses for connectors of electrical conductors.
- 446, Amusement Devices: Toys, subclass 219 for toys having optical fibers.
- 451, Abrading, subclasses 41+ for a process of grinding glass.
- 501, Compositions: Ceramic, subclass 37 for the ceramic composition of an optical fiber.
- 505, Superconductor Technology: Apparatus, Material, Process, appropriate subclasses.
- 600, Surgery, subclasses 101+, for surgical specula including endoscopes, subclasses 184+, 248+, and 249 for other surgical diagnostic implementations.
- 601, Surgery: Kinesitherapy, subclasses 15+ for optical kinesitherapy.

### SECTION III - GLOSSARY

#### CONNECTING

The physical or mechanical joining of optical waveguiding structures to provide a stable region of light transfer therebetween. The waveguiding structures which are joined together are characterized by terminal ends which are mechanically prepared. This includes ferrule type housings for demountable as well as permanent connections, mechanical sleeves which partially or wholly surround and secure the ends of the structures or the light transfer regions, and "assistance-type" struc-

tures which serve to align and guide the ends of waveguiding structures into an effective light transfer relationship. The waveguiding structures which can be connected (as defined herein) include optical fibers, optical fiber bundles, nonfiber-like optical waveguides, and electro-optical transmitting or receiving devices (e.g., semiconductor laser diodes).

#### COUPLING

The interchange of light radiation among or between waveguiding structures, wherein the mechanical interconnection between the structures is of little or no importance. The radiation interchange may be accomplished through any of a number of physical phenomena, including the evanescent wave coupling phenomenon, various modal coupling phenomena, refraction, reflection, as well as through induced changes in structure parameters which govern light transmission (for example, electro-optically or electromagnetically induced refractive index changes in an "interaction" or coupling region). However, devices for input/output of a light wave to/from an optical confinement area, or devices for manipulating an optical wave within or adjacent to an optical confinement area, which employ holography, are classified in the holography area of the Class 359 schedule.

#### INPUT-OUTPUT COUPLING

The introduction of electromagnetic light radiation into an optical waveguiding structure from a source which is external to the structure, or the extraction of electromagnetic light radiation from an optical waveguiding structure to a detecting device at its exterior. This term ("input-output coupling") is specifically defined to include only the coupling of light from a source (e.g., a laser) into an optical waveguide or the coupling of light from an optical waveguide to a detector (e.g., a photodiode), and thus excludes the coupling of light between optical waveguides.

#### LIGHT TRANSMITTING ROD

Any optically transparent elongated structure used to transmit light from one end to the other end by other than modal transmission (e.g., in a random fashion).

#### OPTICAL FIBER

A light transmitting (optical) waveguide formed in a generally cylindrical form, often of extremely small diameter and of great length, which confines the transmitted radiation therewithin by means of the principle of

total internal reflection. Optical fibers are usually comprised of a central light transmitting core of relatively high refractive index, surrounded by a concentric cladding of relatively low refractive index.

#### OPTICAL WAVEGUIDE

An optical waveguide is a waveguide which guides radiation in the visible and near-visible portions of the spectrum by means of total internal reflection.

#### TOTAL INTERNAL REFLECTION

A principle based upon Snell's Law, which defines the relationship between incident and refracted light rays at a boundary between two media of different refractive indices:  $n_1 \sin Q_1 = n_2 \sin Q_2$  where  $n_1$  = refractive index of first medium;  $n_2$  = refractive index of second medium;  $Q_1$  = angle of incident ray at boundary;  $Q_2$  = angle of refracted ray at boundary; For  $Q_2 = 90$  degrees, the critical angle of incidence is given by  $Q_c = \sin^{-1}(n_2/n_1)$ . At angles of incidence greater than  $Q_c$ , the light is reflected from the boundary.

#### TOTALLY REFLECTORIZED

The state of an optical element having all of its inward facing lateral surfaces made reflectors, as for example by the coating thereof with a reflective metal.

#### WAVEGUIDE

A waveguide is defined as any structure capable of guiding electromagnetic radiation in a direction parallel to its axis, while substantially confining the radiation to a region within and adjacent to its surfaces.

#### SUBCLASSES

##### 1 TEMPORAL OPTICAL MODULATION WITHIN AN OPTICAL WAVEGUIDE:

This subclass is indented under the class definition. Subject matter wherein a device varies a property of light as a function of time only as it traverses the waveguide where such variation is in accordance with a varying signal which can be of any energy form.

- (1) Note. Such properties of the traversing light include amplitude, frequency, phase, or polarization.

- (2) Note. The variation can be imparted through elasto-optic, magneto-optic, acousto-optic, etc., interactions with the waveguide.
- (3) Note. Elasto-optic modulation involves varying a property of a light wave propagating in an optical waveguide by a mechanical stressing applied thereto.
- (4) Note. Magneto-optic modulation involves varying a property of a light wave propagating in an optical waveguide by a magnetic field applied thereto.
- (5) Note. Acousto-optic modulation involves varying a property of a light wave propagating in an optical waveguide by a modulating sonic (acoustic) wave applied thereto.
- (6) Note. The modulation must take place exclusively within the waveguide. Optical modulation occurring outside of a waveguide is classified in Class 359.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

4+, for directional modulation within fiber optics.

SEE OR SEARCH CLASS:

359, Optics: Systems (Including Communication) and Elements, subclasses 238+ for light wave temporal modulation outside of a waveguide.

##### 2

##### Electro-optic:

This subclass is indented under subclass 1. Subject matter wherein the optical properties of an optical waveguiding element which determine the temporal modulation are varied by an applied modulating electrical field.

- (1) Note. Includes electro-optic modulation within an optical waveguide using a particular optical coupling (for example, between juxtaposed (adjacent) waveguides). Also, included is electro-optic modulation performed by a combination of components integrated on a common substrate or chip.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

8, for directional electro-optic modulation within an optical waveguide.

SEE OR SEARCH CLASS:

359, Optics: Systems (Including Communication) and Elements, subclasses 245+ for electro-optic temporal modulation outside of an optical waveguide.

### 3 **Phase modulation type:**

This subclass is indented under subclass 2. Subject matter wherein the normal zero phase of a constant amplitude optical wave (i.e., carrier wave) is shifted by an angle proportional to the amplitude of an impressed signal (i.e., modulating signal).

(1) Note. A sinusoidal signal of zero phase will have a zero amplitude at the intersection of the x-y axis.

SEE OR SEARCH CLASS:

359, Optics: Systems (Including Communication) and Elements, subclasses 238+ for temporal phase modulation outside of a waveguide.

### 4 **DIRECTIONAL OPTICAL MODULATION WITHIN AN OPTICAL WAVEGUIDE:**

This subclass is indented under the class definition. Subject matter wherein the path of a light wave exiting a waveguide is varied in accordance with a varying signal applied to the waveguide which can be of any energy form.

(1) Note. The directional modulation must take place exclusively within the waveguide. Optical directional modulation occurring outside of a waveguide is classified in Class 359.

(2) Note. This includes elasto-optic directional modulation, wherein deflection of a light wave output from an optical waveguide is varied in synchronization with the amplitude of an impressed mechanical stressing thereof.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

1+, for light wave temporal modulation within an optical waveguide wherein the light beam is modulated relative to time in accordance with the modulating input signal.

SEE OR SEARCH CLASS:

359, Optics: Systems (Including Communication) and Elements, subclasses 298+ for optical directional modulation out-side of an optical waveguide.

### 5 **Light intensity dependent (e.g., nonlinear effects):**

This subclass is indented under subclass 4. Subject matter wherein the directional modulation is a function of the amplitude of the incident light wave itself.

(1) Note. Includes thermo-optic directional modulation, wherein deflection of a light wave output from an optical waveguide is varied in response to the intensity of applied thermal radiation.

### 6 **Magneto-optic:**

This subclass is indented under subclass 4. Subject matter wherein properties of an optical waveguiding element which determine the directional modulation are controlled by a modulating magnetic field applied to the element.

SEE OR SEARCH CLASS:

359, Optics: Systems (Including Communication) and Elements, subclasses 298+ for magneto-optic directional modulation outside of a waveguide.

### 7 **Acousto-optic:**

This subclass is indented under subclass 4. Subject matter wherein properties of an optical waveguiding element which determine the directional modulation are controlled by a modulating sonic wave applied to the element.

SEE OR SEARCH CLASS:

181, Acoustics, appropriate subclasses for acoustic devices, in general.

- 359, Optics: Systems (Including Communication) and Elements, subclasses 305+ for acousto-optic directional modulation outside of a waveguide.
- 367, Communications, Electrical: Acoustic Wave System and Devices, subclasses 140+ for acoustic transducers.
- 8 Electro-optic:**  
This subclass is indented under subclass 4. Subject matter wherein the optical properties of an optical waveguiding element which determine the directional modulation are changed by a modulating electrical field applied to the element.
- SEE OR SEARCH CLASS:  
359, Optics: Systems (Including Communication) and Elements, subclasses 315+ for electro-optical directional modulation outside of a waveguide.
- 9 Coupling between waveguides:**  
This subclass is indented under subclass 8. Subject matter wherein coupling between juxtaposed optical transmission elements achieves electro-optic directional modulation.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
15+, for optical waveguide coupling, per se.
- 10 Diffraction grating (e.g., Bragg):**  
This subclass is indented under subclass 8. Subject matter wherein electro-optic directional modulation within a waveguide utilizes an element having a series of very close, equidistant, parallel lines, (i.e., grating) or wherein the waveguide has a grating impressed upon it by an externally applied field.
- SEE OR SEARCH CLASS:  
359, Optics: Systems (Including Communication) and Elements, subclasses 566+ for a diffraction grating, per se.
- 11 POLARIZATION WITHOUT MODULATION:**  
This subclass is indented under the class definition. Subject matter wherein the polarization of an incoming light wave is modified as a result of passing through an optical waveguiding element.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
1+, for time dependent polarization modulation of light within a waveguide.
- SEE OR SEARCH CLASS:  
359, Optics: Systems (Including Communication) and Elements, subclasses 483+ for light polarization without modulation outside of a waveguide.
- 12 OPTICAL WAVEGUIDE SENSOR:**  
This subclass is indented under the class definition. Subject matter wherein an optical waveguide, per se, is responsive to an environmental change.
- (1) Note. This is a residual subclass for generic optical waveguide sensing elements which are not elsewhere classifiable. See the SEARCH CLASS notes below.
- (2) Note. Combinations of an optical waveguide with an external sensing element or sensing elements, per se, that are not optical waveguides, are classified elsewhere.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
94, for optical fiber/nonfiber device connectors which are sealed to exclude the effects of environmental conditions.
- 128, for coated optical fiber waveguides which may also act as a sensor under certain conditions.
- SEE OR SEARCH CLASS:  
73, Measuring and Testing, subclass 293 for optical liquid level sensing; subclasses 488+ for optical speed or acceleration testing; subclass 577 for optical depth sensing; subclass 653 for optical vibration sensing; subclass 705 for optical fluid pressure sensing; subclass 800 for optical stress or strain sensors; and subclass 861.08 for optical sensing of volume and rate of flow.
- 235, Registers, subclass 473 for optical fiber coded record sensors.

- 250, Radiant Energy, subclasses 227.11+ for optical sensing systems employing light conductors and photocells.
- 324, Electricity: Measuring and Testing, subclass 96 for electrical testing using optical means and subclasses 244.1 for a magnetometer that uses optical means.
- 340, Communications: Electrical, subclass 555 for light beam intrusion detection and subclasses 853.1+ for wellbore testing.
- 346, Recorders, subclass 33 for wellbore recording.
- 356, Optics: Measuring and Testing, subclass 73.1 for optical measuring and testing for optical fiber/waveguide inspection.
- 367, Communications, Electrical: Acoustic Wave System and Devices, subclass 25 for wellbore telemetering and subclasses 140+ for acoustic transducers.
- 374, Thermal Measuring and Testing, subclass 131 for thermal sensing using optical fibers.

**13 Including physical deformation or movement of waveguide:**

This subclass is indented under subclass 12. Subject matter wherein the environmental change to be detected produces an alteration in the shape or position of the waveguide.

- (1) Note. Physical deformations include, for example, cutting or breaking of the waveguide, compressing or elongating the waveguide (or of the surrounding coating/substrate), or microbending the waveguide.

**14 INTEGRATED OPTICAL CIRCUIT:**

This subclass is indented under the class definition. Subject matter wherein a combination of transparent, elongated structures or components are formed on a common substrate or chip of monolithic or hybrid construction.

- (1) Note. Components in addition to the optical waveguide might include active optical elements (e.g., LED) or passive elements (e.g., lens).

- (2) Note. An integrated optical circuit including a combination of an optical waveguide and a device of the Class 357 type is classified here provided the combination does not meet the requirement of a still larger system class.

**SEE OR SEARCH THIS CLASS, SUBCLASS:**

- 129, for a planar optical waveguide structure which can be (but is not necessarily) the starting point for many integrated optical circuits.

**SEE OR SEARCH CLASS:**

- 257, Active Solid-State Devices (e.g., Transistors, Solid-State Diodes), subclasses 13, 79-103 and 918 for incoherent light emitting injection luminescent devices, subclasses 80-85 for semiconductor light emitting sources combined with semiconductor light responsive devices, subclasses 10, 11, 21, 53-56, 72, 113-118, 184-189, 225-234, 257, 258, 290-294, 414, and 431-466 for light responsive active semiconductor devices, and subclasses 446 and 499+ for integrated circuit devices with electrically isolated components, in general, and other appropriate subclasses for specific type devices in integrated circuits.
- 356, Optics: Measuring and Testing, subclass 350 for optical ring laser gyros which are often integrated.
- 361, Electricity: Electrical Systems and Devices, subclasses 748 through 796+ for connection of electrical integrated circuits (not optical).
- 372, Coherent Light Generators, appropriate subclasses for details to a laser.
- 438, Semiconductor Device Manufacturing: Process, subclasses 24+ for methods of making a semiconductor integrated circuit having both light emissive and light responsive devices.

**15 WITH OPTICAL COUPLER:**

This subclass is indented under the class definition. Subject matter wherein an optical waveguide is combined with an interface element which enables efficient transfer of light



between the waveguide and a point external to the interface element.

- (1) Note. For the purpose of this schedule, coupling is not the same as connecting.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 53+, for mechanical connecting means which are disconnectable without destroying the optical element (e.g., ferrule type connections).

SEE OR SEARCH CLASS:

- 250, Radiant Energy, subclasses 227.11+ for coupling of optical conductor (waveguide) system to photocell.
- 333, Wave Transmission Lines and Networks, subclass 24 for coupling networks for wave (e.g., microwave, millimeter wave, quasi-optical wave) transmission lines; subclasses 141, 150 and 157 for delay lines of wave transmission networks; and subclass 209 for waveguide tunable filters for wave transmission networks.
- 356, Optics: Measuring and Testing, subclass 352 for optical Fabry-Perot cavities.

**16 Switch (i.e., switching from one terminal to another, not modulation):**

This subclass is indented under subclass 15. Subject matter wherein the output of an optical waveguide is selectively coupled to the input of a different optical waveguide.

- (1) Note. These couplings are not necessarily physically connected.
- (2) Note. This subclass is for switching without any specifically mentioned computation or modulation.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 41, and 42, for directional couplers which could be employed as switches and subclasses 4+ for directional optical modulation in waveguides (e.g., for scanning).

SEE OR SEARCH CLASS:

- 200, Electricity: Circuit Makers and Breakers, appropriate subclasses for electrical switches.
- 310, Electrical Generator or Motor Structure, subclasses 310+ for piezoelectric elements and devices.
- 348, Television, subclass 197 for optical scanning with fiber optics.
- 359, Optical: Systems and Elements, subclass 107 and 108 for switching utilized in optical computation; and subclass 618 for light dividing and combining arrangements utilizing single channel to /from plural channels.
- 398, Optical Communications, subclasses 43 through 103 for an optical multiplex communication system which may include an optical waveguide and switch.

**17 Matrix switch (i.e., M X N, where M and N are 3 or more):**

This subclass is indented under subclass 16. Subject matter wherein a plurality of switches can selectively couple light on any of M input waveguides to any of N output waveguides where the M input waveguides and the N output waveguides form a rectilinear array.

**18 Reflective-type switch:**

This subclass is indented under subclass 16. Subject matter wherein selective coupling of light between waveguides is achieved by mirror or mirrorlike elements.

SEE OR SEARCH CLASS:

- 359, Optics: Systems (Including Communication) and Elements, subclasses 838+ for mirrors, in general.

**19 Stationary waveguides with movable opaque element:**

This subclass is indented under subclass 16. Subject matter wherein an optically nontransmissive device moving into or out of the optical path between stationary waveguides provides the switching effect.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 73, for optical fiber connectors having an optical element between facing optical fiber end faces.
- 140, for optical waveguide attenuators.

SEE OR SEARCH CLASS:

- 359, Optics: Systems (Including Communication) and Elements, subclasses 227+ for light control by moving an opaque element or medium in or through a light path.

## 20 **Multiple pole multiple throw:**

This subclass is indented under subclass 16. Subject matter wherein the optical switch operates to selectively couple light between a plurality of input waveguides and any one of their respective plurality of output waveguides.

- (1) Note. Switching of all input waveguides takes place simultaneously.
- (2) Note. The number of output waveguides associated with each input waveguide is the same.

## 21 **Double pole multiple throw:**

This subclass is indented under subclass 20. Subject matter wherein the optical switch operates to selectively couple light between a pair of input waveguides and any one of their respective plurality of output waveguides.

- (1) Note. Switching of both input waveguides takes place simultaneously.
- (2) Note. The number of output waveguides associated with each input waveguide is the same.

## 22 **Single pole multiple throw (relay switch):**

This subclass is indented under subclass 16. Subject matter wherein the optical switch operates to selectively couple light from a single input waveguide to any one of a plurality of output waveguides.

## 23 **Single pole single throw:**

This subclass is indented under subclass 16. Subject matter wherein the optical switch operates to selectively couple light from a single input waveguide to a single output waveguide.

## 24 **Plural (e.g., data bus):**

This subclass is indented under subclass 15. Subject matter wherein an optical waveguide is used as a common trunk line to which a number of terminals can be interconnected through optical couplers.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 46, Star coupler, for input only on one specified input terminal which is distributed to many terminals.

SEE OR SEARCH CLASS:

- 341, Coded Data Generation or Conversion, subclass 137 for analog to digital and digital to analog conversion utilizing fiber optics.
- 345, Computer Graphics Processing and Selective Visual Display Systems, subclasses 180+ for light pens used as input devices for visual display systems with selective electrical control.
- 359, Optics: Systems (Including Communication) and Elements, subclass 118 for multiplexed optical local area networks (LANS), subclass 127 for wavelength division or frequency division multi-plexing by optical coupling; subclass 173 for optical communication systems including a transmitter, a receiver, and an optical waveguide; and subclasses 107+ for optical computing.
- 365, Static Information Storage and Retrieval, subclass 112 for optically performed static storage/retrieval of data.
- 369, Dynamic Information Storage or Retrieval, subclass 18 for optically performed dynamic storage/retrieval of data.
- 379, Telephonic Communications, subclasses 53 and 56 for optically performed telephonic communications.

- 25 Movable coupler:**  
This subclass is indented under subclass 15. Subject matter wherein the coupler may be repositioned about a fixed optical waveguide.
- 26 Slip ring:**  
This subclass is indented under subclass 25. Subject matter having a structure which permits coupling of light during relative rotary motion of elements contained therein.
- (1) Note. The most common slip-ring configuration is the rotor/stator arrangement, with either or both rotating continuously with respect to each other, and with optical radiation continuously being coupled across the gap.
- SEE OR SEARCH CLASS:  
359, Optics: Systems (Including Communication) and Elements, subclass 554 for stabilization of images transmitted by means of optical elements, and subclass 196 for derotation prisms.
- 27 Particular coupling function:**  
This subclass is indented under subclass 15. Subject matter wherein the coupling achieves a specified operation on the light entering or exiting the waveguide.
- 28 Coupling between modes in a waveguide or fiber:**  
This subclass is indented under subclass 27. Subject matter wherein coupling is achieved between light modes in an optical waveguide.
- 29 Mode strippers:**  
This subclass is indented under subclass 28. Subject matter wherein a particular mode or modes of light propagating in a waveguide is extracted by a coupler.
- 30 Evanescent wave coupling:**  
This subclass is indented under subclass 27. Subject matter wherein the desired coupling function is achieved by matching the propagation constants of light travelling in coupled waveguides (also resulting in overlapping evanescent fields).
- (1) Note. The structure of evanescent wave couplers often includes the removal of most of the waveguide cladding material in the actual coupling region.
- SEE OR SEARCH CLASS:  
451, Abrading, subclasses 41+ for a process of abrading a glass substrate (a typical technique for forming evanescent wave couplers).
- 31 Input/output coupler:**  
This subclass is indented under subclass 15. Subject matter including an element which permits efficient transfer of light into or out of the waveguide.
- SEE OR SEARCH CLASS:  
398, Optical Communications, subclasses 79 through 81 for a communication system which may include an optical waveguide and I/O coupler.
- 32 Coupling light through a waveguide bend or loop:**  
This subclass is indented under subclass 31. Subject matter wherein light is coupled into or out of an optical waveguide through a curved portion whose radius of curvature is smaller than that required to confine light therein.
- 33 Lens:**  
This subclass is indented under subclass 31. Subject matter wherein the coupling element focuses light by refraction.
- SEE OR SEARCH CLASS:  
359, Optics: Systems (Including Communication) and Elements, subclasses 642+ for lens elements, per se, and subclasses 362+ for compound lens systems.
- 34 Rod type:**  
This subclass is indented under subclass 33. Subject matter wherein the coupling lens has the form of an elongated cylinder.
- 35 Spherical:**  
This subclass is indented under subclass 33. Subject matter wherein the coupling lens has the form of a globe.

- 36 Prism:**  
This subclass is indented under subclass 31. Subject matter wherein coupling is performed by a double refracting element.
- SEE OR SEARCH CLASS:  
359, Optics: Systems (Including Communication) and Elements, subclasses 831+ for prism elements, per se.
- 37 Grating:**  
This subclass is indented under subclass 31. Subject matter wherein coupling is performed by a diffraction grating.
- SEE OR SEARCH CLASS:  
359, Optics: Systems (Including Communication) and Elements, subclasses 566+ for optical grating structure and subclass 34 for holographic diffraction elements in combination with optical waveguides.
- 38 End fire:**  
This subclass is indented under subclass 31. Subject matter wherein the coupler comprises the optical medium immediately adjacent one end of the waveguide.
- 39 Particular coupling structure:**  
This subclass is indented under subclass 15. Subject matter wherein details of the structure of the coupler are recited.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
27, for a specified function achieved by a coupler.
- 40 Electrodes on or near the coupling region:**  
This subclass is indented under subclass 39. Subject matter wherein electrically conductive terminals are adjacent to an optical energy transfer zone.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
2, for electro-optic temporal modulation within a waveguide.  
8, for electro-optic directional modulation within a waveguide.
- 41 Directional coupler:**  
This subclass is indented under subclass 40. Subject matter wherein interconnected optical paths of a coupler are externally activated to enable input on a first optical path to be coupled only to a second optical path for optical beam transmission, and a received optical beam on a third optical path is coupled only to the first optical path.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
42, for directional couplers which do not require an external electrical field stimulus for their operation.
- 42 Directional coupler:**  
This subclass is indented under subclass 39. Subject matter wherein interconnected optical paths of a coupler enable input on a first optical path to be coupled only to a second optical path for optical beam transmission and a received optical beam on a third optical path is coupled only to the first optical path.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
41, for directional couplers which require an external electrical field stimulus for their operation.
- 43 Tapered coupler:**  
This subclass is indented under subclass 39. Subject matter wherein a physical dimension or optical characteristic of the waveguide core or cladding increases or decreases continuously with distance along the axis of the guide, and wherein this increase or decrease in dimension is essential to the coupling function.
- (1) Note. Included here are the "biconically tapered, fused optical fiber couplers" (both single mode and multimode).
- 44 "T" coupler or duplex coupler:**  
This subclass is indented under subclass 39. Subject matter wherein the coupler has two perpendicular waveguide legs forming a tee which connects an input port to two output ports or two input ports to a single output port.

**45 "Y" coupler:**

This subclass is indented under subclass 39. Subject matter wherein the coupler has three waveguide legs joined at the center in a "Y" shape which connects an input port to two output ports or two input ports to a single output port.

- (1) Note. This differs from a "T" coupler only in the geometrical configuration of the three legs.

**46 Star coupler:**

This subclass is indented under subclass 39. Subject matter wherein a passive coupler distributes light from one or more input waveguides among a larger number of output waveguides.

SEE OR SEARCH THIS CLASS, SUB-CLASS:  
24, for an optical data bus.

SEE OR SEARCH CLASS:

398, Optical Communications, subclasses 61 through 64 for optically multiplexed local area networks (LANS) utilizing active and passive Star couplers.

**47 Multiport coupler using reflective surface:**

This subclass is indented under subclass 39. Subject matter wherein an optical beam is coupled to plural zones by mirror type elements.

- (1) Note. This includes a beam splitter containing a reflective surface.

SEE OR SEARCH CLASS:

359, Optics: Systems (Including Communication) and Elements, subclass 618 for beam splitters and combiners in other optical arrangements.

**48 Access couplers, power tappers, or power dividers:**

This subclass is indented under subclass 39. Subject matter wherein the coupler structure permits optical linking with a waveguide without providing a load thereto.

**49 Fiber to thin film devices:**

This subclass is indented under subclass 39. Subject matter wherein at least one optical fiber and at least one thin film optical device are coupled to allow efficient light propagation therebetween.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

88, for connector structures involving at least one optical fiber and at least one nonfiber optical device.

**50 Waveguide to waveguide:**

This subclass is indented under subclass 39. Subject matter wherein two or more optical waveguides are coupled to allow efficient light propagation therebetween.

- (1) Note. The waveguides may be planar or fiber type.

**51 Permanently fixed coupler:**

This subclass is indented under subclass 15. Subject matter wherein the optical waveguide and coupler are physically joined together by a permanent connection (e.g., welding, epoxy, or adhesive putty).

SEE OR SEARCH THIS CLASS, SUB-CLASS:

91, for permanently fixed connections between optical fibers and nonfiber devices.

95, for optical fiber waveguide splice arrangements.

**52 With alignment device:**

This subclass is indented under subclass 15. Subject matter including a device which maintains the mutual spatial orientation between coupled waveguides.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

136, for external retainers.

137, for optical fiber holders.

**53 WITH DISENGAGEABLE MECHANICAL CONNECTOR:**

This subclass is indented under the class definition. Subject matter wherein an optical fiber or optical fiber bundle is combined with structure

- utilized in the reversible mechanical joining of the fiber or bundle with another such combination or with an individual fiber, bundle, or broadly recited optical device.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
95+, for a permanent-type connection (i.e., splice).
- SEE OR SEARCH CLASS:  
361, Electricity: Electrical Systems and Devices, subclasses 748 through 796 + for electrical connection to printed circuit boards.  
425, Plastic Article or Earthenware Shaping or Treating: Apparatus, subclass 802 for cable tube or rod splicing.  
439, Electrical Connectors, for electrical connector structure in general.
- 54 Structure surrounding optical fiber bundle-to-bundle connection:**  
This subclass is indented under subclass 53. Subject matter wherein the joining of a fiber bundle to another is secured by a device enveloping the junction.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
55, for structure surrounding fiber-to-fiber connection.  
115, for optical fiber bundles, per se.
- 55 Structure surrounding optical fiber-to-fiber connection:**  
This subclass is indented under subclass 53. Subject matter wherein the joining of an individual fiber to another is secured by an element enveloping the junction.
- (1) Note. This includes, for example, extensive sleeve structure.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
54, for structure surrounding bundle-to-bundle connection.  
123, for optical fiber waveguides, per se.
- 56 Multi-part (e.g., two pieces screwed together or bayonet latched):**  
This subclass is indented under subclass 55. Subject matter wherein the enveloping element consists of a plurality of interengaging parts each associated with an individual fiber.
- 57 Magnetically actuated:**  
This subclass is indented under subclass 56. Subject matter wherein the multi-part connection is achieved by applying a magnetic field.
- 58 With additional structure at or immediately surrounding each optical fiber end face:**  
This subclass is indented under subclass 56. Subject matter including details of structure at or near the terminal surface of a fiber contained within the connector.
- 59 Plural fiber-to-fiber connections:**  
This subclass is indented under subclass 58. Subject matter wherein pairs of corresponding multiple fibers are connected in a specified manner.
- 60 Fiber end held in ferrule:**  
This subclass is indented under subclass 58. Subject matter wherein one end of the fiber is contained in a strengthening terminal element having an aperture comparable in size to the fiber cross-sectional diameter.
- 61 Lens-shaped ferrule:**  
This subclass is indented under subclass 60. Subject matter wherein the ferrule is transparent and has a refracting outer surface.
- (1) Note. This subclass also includes those ferrules having a separate lens there-within.
- SEE OR SEARCH CLASS:  
359, Optics: Systems (Including Communication) and Elements, subclasses 642+ for a lens element, per se.
- 62 Compressively fixed (e.g., chuck, collet, crimp, set screws, etc.):**  
This subclass is indented under subclass 60. Subject matter wherein the fiber is locked in place within the ferrule by applying mechanical pressure.

**63 Plate-type holding structure (e.g., jewel):**  
This subclass is indented under subclass 60. Subject matter wherein the ferrule has a planar surface through which the fiber passes.

- (1) Note. "Jewels" are made of a very hard material and have an accurately machined hole therein for accommodating the optical fiber.

**64 Plural rods or balls structure:**  
This subclass is indented under subclass 60. Subject matter wherein the ferrule includes multiple elongated or spherical components.

**65 Groove-type holding structure:**  
This subclass is indented under subclass 60. Subject matter wherein the fiber is supported within the ferrule by a structure having a surface recess parallel to the long axis of the fiber.

**66 Tube-type holding structure:**  
This subclass is indented under subclass 60. Subject matter wherein the fiber is supported within the ferrule by a cylindrical structure.

**67 Eccentric arrangement:**  
This subclass is indented under subclass 66. Subject matter wherein the tube is arranged so that its longitudinal axis is parallel to, but spaced from, the longitudinal axis of the ferrule; thereby, making it off-center with respect to the ferrule.

**68 Capillary tubes:**  
This subclass is indented under subclass 66. Subject matter wherein the tube holding the fiber has a bore which is just slightly larger than the diameter of the fiber itself.

**69 With additional structure rearward of fiber joint to secure additional cable layers:**  
This subclass is indented under subclass 56. Subject matter which includes structure offset from the fiber joint in a direction along the fiber axis where such structure prevents undesired motion of layers concentric with and outside of the fiber itself.

- (1) Note. The additional cable layers may be secured by means of adhesive, by crimping, etc.

- (2) Note. This subclass includes the so-called "cable joints".

SEE OR SEARCH CLASS:

- 285, Pipe Joints or Couplings, subclass 260 for pliable, nonmetallic pipe couplings.

**70 With additional structure at or immediately surrounding each optical fiber end face:**

This subclass is indented under subclass 55. Subject matter detailing structure at or near the terminal surface of a fiber contained within the connector.

- (1) Note. This subclass differs from subclass 56 in that a single mechanical structure surrounding the joint is addressed, whereas subclass 56 requires separate mechanical structure associated with each side of the joint and with the separate structures being interengaged (e.g., screwed together)

**71 Plural fiber-to-fiber connections:**

This subclass is indented under subclass 70. Subject matter wherein the fiber structures joined each include multiple fibers.

**72 Fiber end held in ferrule:**

This subclass is indented under subclass 70. Subject matter wherein the terminal edge of a fiber is supported and protected by an element which has an opening for the fiber.

**73 With additional optical element between facing fiber ends:**

This subclass is indented under subclass 55. Subject matter wherein there is a component performing an optical function which is located between the fiber and its mating fiber.

- (1) Note. The optical elements include filters, apertures, index matching media, etc.

**74 Lens:**

This subclass is indented under subclass 73. Subject matter wherein the optical component focuses transiting light waves.

- SEE OR SEARCH CLASS:  
359, Optics: Systems (Including Communication) and Elements, subclasses 642+ for a lens element, per se.
- 75 With additional nonoptical structure:**  
This subclass is indented under subclass 55. Subject matter including supplemental structure not having an optical function.
- (1) Note. This includes, for example, electrically conducting elements which are mated simultaneously with the optical elements.
- SEE OR SEARCH CLASS:  
439, Electrical Connectors, appropriate subclasses for purely electrical connectors.
- 76 Optical fiber/optical fiber cable termination structure:**  
This subclass is indented under subclass 53. Subject matter detailing structure situated at the end of one fiber or fiber cable which is to form one half of the optical junction.
- 77 At or immediately surrounding an optical fiber end face:**  
This subclass is indented under subclass 76. Subject matter detailing structure at or concentric with the terminal surface of a fiber.
- 78 Fiber end held in ferrule:**  
This subclass is indented under subclass 77. wherein one end of the fiber is contained in a strengthening terminal element having an aperture comparable in size to the fiber cross-sectional diameter.
- 79 Lens-shaped ferrule:**  
This subclass is indented under subclass 78. Subject matter wherein the ferrule is shaped in such a fashion that it focuses light at a predetermined point.
- (1) Note. This subclass also includes those ferrules having a separate lens there-within.
- 80 Adhesively fixed:**  
This subclass is indented under subclass 78. Subject matter wherein the fiber is secured to the ferrule with glue.
- SEE OR SEARCH CLASS:  
156, Adhesive Bonding and Miscellaneous Chemical Manufacture, appropriate subclasses.
- 81 Compressively fixed (chuck, collet, crimp, set screw, etc.)**  
This subclass is indented under subclass 78. Subject matter wherein the fiber is secured to the ferrule by a structure providing mechanical pressure.
- 82 Plural rods or balls structure:**  
This subclass is indented under subclass 78. Subject matter wherein the ferrule includes multiple elongated or spherical components.
- 83 Groove-type holding structure:**  
This subclass is indented under subclass 78. Subject matter wherein the fiber is supported in a structure which has a recessed slot parallel to the longitudinal axis of the fiber.
- 84 Tube-type holding structure:**  
This subclass is indented under subclass 78. Subject matter wherein the fiber is supported within the ferrule by a cylindrical structure.
- (1) Note. Included here are terminating ferrules with capillary tube structure and eccentrically arranged tube structure.
- 85 Fiber/ferrule further processed (grinding, polishing, etc.):**  
This subclass is indented under subclass 78. Subject matter including treatment of the fiber/ferrule assembly.
- SEE OR SEARCH CLASS:  
65, Glass Manufacturing, appropriate subclasses for glassworking.  
83, Cutting, subclass 913 for cutting optical fibers or filaments.  
156, Adhesive Bonding and Miscellaneous Chemical Manufacture, subclasses 625+ for etching processes.



- 225, Severing by Tearing or Breaking, subclass 94 for apparatus for scribing then breaking optical fibers.
- 451, Abrading, subclasses 41+ for a process of abrading optical fibers.
- 86 Structure rearward of optical fiber end face to secure additional fiber or cable layers:**  
This subclass is indented under subclass 76. Subject matter which includes structure offset from the fiber end in a direction along the fiber axis where such structure prevents undesired motion of layers concentric with and outside of the fiber itself.
- 87 Having at least one layer compressively fixed (e.g., crimp, tightening screws, etc.):**  
This subclass is indented under subclass 86. Subject matter wherein a layer is secured by a structure which exerts a mechanical pressure thereupon.
- 88 Optical fiber to a nonfiber optical device connector:**  
This subclass is indented under subclass 53. Subject matter wherein a device for mechanically joining a fiber to an additional optical device is recited.
- (1) Note. Typical nonfiber optical devices could include semiconductor lasers, LED's, photodiodes, etc. However, where significant detail to the nonfiber device is recited, classification is elsewhere. See SEARCH CLASS notes below.
- SEE OR SEARCH CLASS:
- 250, Radiant Energy, subclasses 227.11+ for optical fiber waveguides in a pre-photo-cell system.
- 257, Active Solid-State Devices (e.g., Transistors, Solid-State Diodes), subclasses 13, 79-103 and 918 for incoherent light emitting injection luminescent devices, subclasses 80-85 for semiconductor light emitting sources combined with semiconductor light responsive devices, subclasses 10, 11, 21, 53-56, 72, 113-118, 184-189, 225-234, 257, 258, 290-294, 414, and 431-466 for light responsive active semiconductor devices, and subclasses 446 and 499+ for integrated circuit devices with electrically isolated components, in general, and other appropriate subclasses for specific type devices in integrated circuits.
- 89 Plural fiber/device connections:**  
This subclass is indented under subclass 88. Subject matter detailing connection between single fiber to plural de-vices, plural fibers to a single device, or a plurality of paired fiber/device connections.
- 90 Fiber adjustable relative to device:**  
This subclass is indented under subclass 88. Subject matter including structure to reposition the fiber relative to the device.
- 91 Fiber permanently fixed after adjustment:**  
This subclass is indented under subclass 90. Subject matter wherein the fiber is locked in place relative to the second device, for example, by adhesive means or by soldering, etc.
- 92 With housing:**  
This subclass is indented under subclass 88. wherein the connection is enclosed in a protective structure.
- SEE OR SEARCH CLASS:
- 361, Electricity: Electrical Systems and Devices, subclasses 600+ for generic electrical housings.
- 93 Including lens:**  
This subclass is indented under subclass 92. Subject matter wherein the housing incorporates a focusing device therein.
- SEE OR SEARCH CLASS:
- 359, Optics: Systems (Including Communication) and Elements, subclasses 642+ for a lens element, per se.
- 94 Sealed from environment:**  
This subclass is indented under subclass 92. Subject matter wherein the housing provides a hermetic barrier between the connection and ambient conditions.

- 95 WITH SPLICE (PERMANENT CONNECTION):**  
This subclass is indented under the class definition. Subject matter wherein two fibers are joined together in such a fashion that they may not be subsequently separated.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
53+, for a disengageable mechanical optical connector.
- SEE OR SEARCH CLASS:  
65, Glass Manufacturing, subclasses 4.1 through 4.3 for methods of joining glass optical fibers.  
156, Adhesive Bonding and Miscellaneous Chemical Manufacture, subclass 158 for methods of bonding fibers (of indefinite length) end-to-end.  
219, Electric Heating, subclasses 121.36+ for methods and apparatus for fusion splicing optical fibers.  
425, Plastic Article or Earthenware Shaping or Treating: Apparatus, subclass 802 for cable tube or rod splicing.
- 96 Fusion splicing:**  
This subclass is indented under subclass 95. Subject matter wherein the splice is formed by high temperature melting and rejoining.
- 97 Alignment of fiber ends prior to splicing:**  
This subclass is indented under subclass 95. Subject matter wherein a particular orientation between the fibers to be spliced is specified.
- 98 End-to-end (butt) coupling:**  
This subclass is indented under subclass 97. Subject matter wherein the two fibers are colinear and are joined end-to-end.
- 99 Including splice joint reinforcement:**  
This subclass is indented under subclass 95. Subject matter wherein structure is provided to strengthen the spliced connection.
- 100 OPTICAL TRANSMISSION CABLE:**  
This subclass is indented under the class definition. Subject matter wherein an optical fiber or fibers are incorporated into an assembly that provides tensile strength and external protection for the fibers.
- (1) Note. If significant electrical structure is claimed, classification is in Class 174.
- (2) Note. This subclass includes optical fiber cables having additional transmission means such as electrical conductors within the cable where the optical fibers transmit light.
- (3) Note. Sometimes the optical fibers within the cable are helically or reverse helical (S-Z) wound in order to provide protection thereto.
- (4) Note. A single optical conductor with a protective coating not providing tensile strength is classified in subclass 128. A single conductor with cladding not used for protection is classified in subclasses 123+.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
115+, for an optical fiber bundle which is not in an assembly providing tensile strength and external protection thereto.  
123+, for an optical fiber waveguide with cladding, per se.
- SEE OR SEARCH CLASS:  
57, Textiles: Spinning, Twisting, and Twining, subclasses 3 through 19 for cable forming when twisting is involved.  
138, Pipes and Tubular Conduits, appropriate subclasses for cable containing ducts.  
174, Electricity: Conductors and Insulators, subclasses 68.1+ for electrical cable structure in general.  
226, Advancing Material of Indeterminate Length, subclasses 1 through 8 for advancing fibers through tubes (i.e., so as to form cables).  
242, Winding, Tensioning, or Guiding, especially subclass 920 for winding a glass strand.

- 101 With electrical conductor in the same cable:**  
This subclass is indented under subclass 100. Subject matter wherein the optical cable additionally contains an electrical conductor therein.
- SEE OR SEARCH CLASS:  
174, Electricity: Conductors and Insulators, subclass 70 for a combined electrical/optical cable having significant electrical cable detail.
- 102 Tightly confined (i.e., fiber tightly held inside the outer sheath):**  
This subclass is indented under subclass 100. Subject matter wherein adjacent optical fiber or fibers have their collective movement restricted by a surrounding sheath and strength element of the cable.
- (1) Note. Included in this subclass are those tightly confined cables having a strength element (e.g., a steel wire) external to the primary cable structure.
- 103 Having a central strength member:**  
This subclass is indented under subclass 102. Subject matter wherein the tightly confined cable includes at its center an element which prevents excessive cable bending.
- (1) Note. The strength member can be made of metal, plastic, yarn, etc.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
113, for loose tube type cable with strength member.
- 104 Particular fiber orientation (e.g., helically wound, etc.):**  
This subclass is indented under subclass 102. Subject matter wherein the fibers within a cable have a specified spatial interrelationship (for example, helically wound, S-Z stranded, etc.).
- 105 Compartmentalized:**  
This subclass is indented under subclass 102. Subject matter wherein the optical fibers within a cable are grouped and each group is kept distinct by a separator.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
110, for compartmentalized loose tube type cable.
- 106 Plural unit type(plural complete cables within a single outside sheath):**  
This subclass is indented under subclass 102. Subject matter wherein multiple complete cables are confined within a single outside sheath.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
112, for plural unit loose tube type cables.
- 107 With armoring:**  
This subclass is indented under subclass 102. Subject matter wherein the optical fibers of the cable are encased in a concentric metallic sleeve or in a sleeve made of a plurality of armor wires.
- 108 Prestressed:**  
This subclass is indented under subclass 107. Subject matter wherein the armoring is mechanically stressed prior to application to the cable.
- (1) Note. The stress can be compression or tension.
- 109 Loose tube type:**  
This subclass is indented under subclass 100. Subject matter wherein the individual fibers within a transmission cable are loosely confined within an outer elongated sheathing structure.
- (1) Note. The fibers can move when stress is applied to the cable or when the cable is flexed.
- 110 Compartmentalized:**  
This subclass is indented under subclass 109. Subject matter wherein the optical fibers within a cable are grouped and each group is kept distinct by a separator.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
105, for compartmentalized tightly confined cable.

**111 Particular fiber orientation:**

This subclass is indented under subclass 109. Subject matter wherein the fibers are placed within the tube in a particular spatial interrelationship (e.g., helically wound, s-z stranded, etc.).

**112 Plural unit type:**

This subclass is indented under subclass 109. Subject matter wherein multiple optical loose tube cables are placed together into one large cable.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

106, for plural unit tightly confined cables.

**113 With strength member:**

This subclass is indented under subclass 109. Subject matter wherein the optical cable includes an element preventing excessive bending thereof.

(1) Note. The strength element can be made of metal, plastic, yarn, etc.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

103, for tightly confined cable with central strength member.

**114 Ribbon cable:**

This subclass is indented under subclass 100. Subject matter wherein a cable is formed of plural parallel optical fibers lying in a single plane.

(1) Note. The ribbon cable may or may not include strength member elements.

**115 OPTICAL FIBER BUNDLE:**

This subclass is indented under the class definition. Subject matter wherein an assemblage of individual optical fibers are placed adjacent one another to guide light collectively.

(1) Note. Nonimaging optical fiber bundles are used primarily for illumination, ornamentation, and display. Optical fiber bundles are rarely used in data transmission.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

100+, for an optical transmission cable which provides protection to the fibers therein.

123+, for an optical fiber waveguide with cladding, per se.

SEE OR SEARCH CLASS:

40, Card, Picture, or Sign Exhibiting, subclasses 546 through 547 for illuminated signs using optical fiber bundles.

340, Communications: Electrical, subclasses 815.42+ for visual indicators utilizing light piping (i.e., optical fiber bundles).

362, Illumination, subclasses 551+ for illumination utilizing optical fibers.

**116 Imaging (i.e., with coherent fiber structure and includes shaping, enhancing, and correcting):**

This subclass is indented under subclass 115. Subject matter wherein images can be transmitted through a fiber bundle by having the individual fiber ends similarly arranged at opposite bundle ends.

(1) Note. An imaging optical fiber bundle is also known as a "coherent" bundle.

SEE OR SEARCH CLASS:

345, Computer Graphics Processing and Selective Visual Display Systems, subclasses 1.1 through 3.4 for visual display systems with selective electrical control wherein the display system may include fiber optics.

399, Electrophotography, subclass 137 for optical intermediate storage of original image formation, subclasses 196+ for variable magnification, subclass 218 for exposure lens, and subclass 219 for exposure of an image formation having fiber optics.

**117 For fiber scope (endoscope):**

This subclass is indented under subclass 116. Subject matter wherein the imaging fiber bundle is used in an instrument to transmit an image of a remote location to the viewing end of the fiber bundle.

- (1) Note. If the fiber scope is adapted for use in a particular art area, classification is in the art area; otherwise, classification is in this class (385).
- (2) Note. Fiber scopes may contain both a coherent fiber optic bundle (for imaging) and a noncoherent bundle (for illumination).

## SEE OR SEARCH CLASS:

- 348, Television, subclasses 65+ for video endoscopes.
- 356, Optics: Measuring and Testing, subclasses 241.1+ for inspection borescopes.
- 359, Optics: Systems (Including Communication) and Elements, subclass 367 for a compound lens right angle inspector.
- 607, Surgery: Light, Thermal, and Electrical Application, subclasses 1+ for light applying instruments.

**118 With manipulator:**

This subclass is indented under subclass 117. Subject matter wherein the fiber scope is combined with structure for manipulation thereof (i.e., sideways, rotational or longitudinal movement).

- (1) Note. Such manipulation can be automatically controlled (e.g., wall-climbing) or can be remotely operated (e.g., control wires).

**119 With lens or mirror:**

This subclass is indented under subclass 116. Subject matter wherein the imaging bundle is combined with an element having two refracting edges or is combined with a reflective device.

## SEE OR SEARCH CLASS:

- 359, Optics: Systems (Including Communication) and Elements, subclasses 642+ for lenses, per se, and subclasses 838+ for mirrors, per se.
- 399, Electrophotography, subclass 137 for optical intermediate storage of original image formation, subclasses 196+ for variable magnification, subclass 218 for exposure lens, and subclass

219 for exposure of an image formation having fiber optics.

**120 Fiber bundle plate:**

This subclass is indented under subclass 115. Subject matter wherein the plural fibers are terminated in a single planar structure.

## SEE OR SEARCH CLASS:

- 313, Electric Lamp and Discharge Devices, subclass 372 for CRT's having optical fiber array structures.
- 348, Television, subclasses 359 and 804 for television systems employing fiber optic arrays.
- 355, Photocopying, subclass 1 for a photocopier with optical fiber arrays.
- 399, Electrophotography, subclass 137 for optical intermediate storage of original image formation and subclass 219 for exposure of an image formation having fiber optics.

**121 Transition between geometric shapes:**

This subclass is indented under subclass 115. Subject matter wherein the fibers in the bundle are geometrically distributed to match the shape of an additional waveguiding structure with which the bundle is to interact.

**122 HAVING NONLINEAR PROPERTY:**

This subclass is indented under the class definition. Subject matter wherein an optical waveguide material having a strong second (or higher) order response function to optical radiation is recited.

- (1) Note. The nonlinear property could include Rayleigh, Brillouin, Raman scattering, etc.

## SEE OR SEARCH CLASS:

- 252, Compositions, subclasses 582+ for light transmission modifying compositions.
- 359, Optics: Systems (Including Communication) and Elements, subclass 240 for light wave temporal modulation via a nonlinear device outside of an optical waveguide, subclass 255 for electro-optic polarization modulation by a nonlinear device, and subclasses 328+ for optical harmonic generators which could use nonlinear optics.

**123 OPTICAL FIBER WAVEGUIDE WITH CLADDING:**

This subclass is indented under the class definition. Subject matter wherein a low refractive index sheathing or covering surrounds a higher index of refraction core of an optical fiber, in order to confine light in the core by means of total internal reflection.

- (1) Note. The fiber waveguides of this subclass are of generally cylindrical configuration.
- (2) Note. Planar type optical waveguides are provided for in subclass 129.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 100+, for an optical transmission cable which provides protection to the fibers therein.
- 115+, for an optical fiber bundle.

SEE OR SEARCH CLASS:

- 65, Glass Manufacturing, subclasses 385+ for processes of forming optical fibers or waveguides, particularly subclasses 413+ for processes of depositing a clad by vapor deposition; subclasses 420+ for processes of doping a clad; and subclass 405 for processes of simultaneously forming clad and core.
- 264, Plastic and Nonmetallic Article Shaping or Treating: Processes, subclasses 1.24+ for shaping, treating, or extruding optical fibers, waveguides, or preforms.
- 428, Stock Material or Miscellaneous Articles, subclasses 364+ for fiber stock material.
- 505, Superconductor Technology: Apparatus, Material, Process, appropriate subclasses for superconductors which could be in optical fiber form.

**124 With graded index core or cladding:**

This subclass is indented under subclass 123. Subject matter wherein the index of refraction of the core or cladding material varies axially or radially.

**125 Utilizing nonsolid core or cladding:**

This subclass is indented under subclass 123. Subject matter wherein the core or cladding material is a liquid or gas.

**126 Utilizing multiple core or cladding:**

This subclass is indented under subclass 123. Subject matter wherein a single waveguide includes plural cladding or core layers.

**127 Concentric:**

This subclass is indented under subclass 126. Subject matter wherein the various core and cladding layers are nested cylinders.

**128 Where the second or further layer is a coating:**

This subclass is indented under subclass 127. Subject matter wherein a coating having no optical property forms an external protective layer around the core.

SEE OR SEARCH CLASS:

- 106, Compositions: Coating or Plastic, appropriate subclasses for coating or plastic compositions.
- 204, Chemistry: Electrical and Wave Energy, subclass 192.29 for sputter coating onto an optical fiber waveguide.
- 260, Chemistry of Carbon Compounds, appropriate subclasses for synthetic resins and organic compounds.
- 427, Coating Processes, subclass 162 and 163.1+ for processes of coating optical fibers, filaments, rods, or waveguides.

**129 PLANAR OPTICAL WAVEGUIDE:**

This subclass is indented under the class definition. Subject matter wherein the optically conductive material includes a flat surface confining the optical beam therein.

- (1) Note. Cylindrically configured optical waveguides are provided for in subclass 123.
- (2) Note. This may include planar waveguides having imaging elements therein (e.g., Luneberg lens).

## SEE OR SEARCH CLASS:

- 117, Single-Crystal, Oriented-Crystal, and Epitaxy Growth Processes; Non-Coating Apparatus Therefor, for processes and non-coating apparatus for growing therein-defined single-crystal of all types of materials, including organic or inorganic, and including those suitable as or to produce an optical waveguide.
- 204, Chemistry: Electrical and Wave Energy, subclass 192.29 for sputter coating onto an optical fiber waveguide.

**130 Thin film optical waveguide:**

This subclass is indented under subclass 129. Subject matter wherein the structure that is used to confine and guide the light through modal transmission is a dielectric rib, planar, or channel waveguide.

- (1) Note. The thin-film is a thin layer of light transmitting material, usually deposited by sputtering or evaporation, that may be made in a pattern to form an optical waveguide on, or adjacent to, a supporting substrate.
- (2) Note. This subclass includes graded index thin-film waveguides.

## SEE OR SEARCH CLASS:

- 359, Optics: Systems (Including Communication) and Elements, subclass 332 for a dielectric optical waveguide used in frequency converters.

**131 Multilayer structure (mixture):**

This subclass is indented under subclass 130. Subject matter wherein the optical waveguide is formed from a plurality of layers for the transmission of light therethrough.

- (1) Note. This might include, for example, a semiconductor npn layer structure forming an optical waveguide structure.

**132 Channel waveguide:**

This subclass is indented under subclass 130. Subject matter wherein the waveguide consists of a channel or depression in the deposited dielectric providing a light path therethrough.

**133 OPTICAL IMAGING TUNNEL:**

This subclass is indented under the class definition. Subject matter wherein an optical device having internally reflecting inner walls is capable of producing multiple images of a point source.

## SEE OR SEARCH CLASS:

- 359, Optics: Systems (Including Communication) and Elements, subclasses 894+ for optical apertures, tubes, or transparent closures.

**134 ACCESSORIES:**

This subclass is indented under the class definition. Subject matter which are devices particularly adapted to be used with optical fibers or other waveguide structures.

## SEE OR SEARCH CLASS:

- 33, Geometrical Instruments, subclass 1 for optical readout and subclasses 227-299 for straightline light ray type instruments.
- 433, Dentistry, subclass 29 for optical dental tools.

**135 Splice box and surplus fiber storage/trays/organizers/carriers:**

This subclass is indented under subclass 134. Subject matter wherein a structure is provided in which one or more fibers may be organized and placed in their required position for proper coupling of optical energy between them.

## SEE OR SEARCH CLASS:

- 211, Supports: Racks, subclasses 13.1+ for special article supports (racks).

**136 External retainer/clamp:**

This subclass is indented under subclass 134. Subject matter wherein an external device is used to provide support to an optical fiber, cable, fiber bundle, or waveguide.

- (1) Note. Included here are pulling eyes, etc.

**137 Fiber holder (i.e., for single fiber or holding multiple single fibers together):**

This subclass is indented under subclass 136. Subject matter wherein the retainer is particularly adapted to hold a single fiber or to hold plural single fibers together.

- (1) Note. These are neither connectors or connector terminals, but rather chuck type structures.

SEE OR SEARCH CLASS:

- 248, Supports, appropriate subclasses for supports in general.  
269, Work Holders, appropriate subclasses for work holders in general.  
279, Chucks or Sockets, appropriate subclasses for chucks in general.

**138 Bushing structure (e.g., penetrator):**

This subclass is indented under subclass 134. Subject matter wherein the accessory is an element insertable through a structure and this accessory forms a lining in the opening thereby protecting an optical fiber or cable passing therethrough.

- (1) Note. The opening is through a wall or bulkhead, for example.

SEE OR SEARCH CLASS:

- 174, Electricity: Conductors and Insulators, subclass 70 for submarine cable repeater housings and subclasses 152+ for an electrical cable bushing.

**139 Plug/termination device:**

This subclass is indented under subclass 134. Subject matter wherein the accessory is an element protecting the end of an optical fiber from the environment.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 76+, for connector terminal structure.

**140 Attenuator:**

This subclass is indented under subclass 134. Subject matter involving a device which reduces the intensity of light entering or exiting a waveguide.

SEE OR SEARCH CLASS:

- 359, Optics: Systems (Including Communication) and Elements, subclasses 599+ for diffusion, subclasses 885+ for absorption filters, and subclasses 227+ for moving discrete opaque elements into or out of light paths.

**141 HAVING PARTICULAR OPTICAL CHARACTERISTIC MODIFYING CHEMICAL COMPOSITION:**

This subclass is indented under the class definition. Subject matter wherein chemical structure which changes a particular light wave parameter is recited.

SEE OR SEARCH CLASS:

- 106, Compositions: Coating or Plastic, appropriate subclasses for plastic compositions.  
252, Compositions, appropriate subclasses for compositions in general.  
260, Chemistry of Carbon Compounds, appropriate subclasses for synthetic resins and organic compounds.  
423, Chemistry of Inorganic Compounds, appropriate subclasses for inorganic chemistry.  
501, Compositions: Ceramic, subclass 37 for ceramic optical fiber compositions.

**142 Of waveguide core:**

This subclass is indented under subclass 141. Subject matter wherein the chemical details of the central light conveying portion of the waveguide which has a relatively high refractive index are recited.

**143 Organic:**

This subclass is indented under subclass 142. Subject matter wherein the composition includes carbon.

**144 Of waveguide cladding:**

This subclass is indented under subclass 141. Subject matter wherein the chemical details of the concentric coating which has a relatively low refractive index and which immediately surrounds the waveguide core are recited.



- 145     Organic:**  
This subclass is indented under subclass 144. Subject matter wherein the composition includes carbon.
- 146     NONCYLINDRICAL OR NONPLANAR SHAPED WAVEGUIDE:**  
This subclass is indented under the class definition. Subject matter wherein the cross section of the waveguide is neither circular nor flat.
- 147     MISCELLANEOUS:**  
This subclass is indented under the class definition. Subject matter not provided for in any of the preceding subclasses.

#### CROSS-REFERENCE ART COLLECTIONS

- 900     SOLAR COLLECTOR OR TRANSMITTER:**  
Art collection relating to devices for the gathering or distribution of light from the sun which utilize optical waveguides.
- 901     ILLUMINATING OR DISPLAY APPARATUS:**  
Art collection of optical waveguides utilized in lighting or sign-type devices.
- 902     NONBUNDLE FIBERSCOPE DEVICES:**  
Art collection of viewing devices of diverse utility which are formed from other than an optical fiber bundle.

END